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A Revised Concept of *Spalangia philippinensis* Fullaway, 1917 (Hymenoptera: Pteromalidae)

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Abstract.—A lectotype male and three paralectotype females are designated for ***Spalangia philippinensis* Fullaway, 1917,** which is removed from synonymy with *S. endius* Walker, 1839, and placed in synonymy with ***S. cameroni* Perkins, 1910, syn. nov.** Two of the female paralectotypes are conspecific with *S. endius*, whereas the third is conspecific with *S. gemina* Bouček, 1963. The revised concept and new synonymy are based on comparison of the original description and illustrations of *S. philippinensis* with the four specimens that are interpreted as syntypes. The lectotype is selected so as to least disrupt current nomenclature while being compatible with the original description. Current concepts of *S. cameroni* and *S. simplex* Perkins, 1910, as interpreted by Bouček (1963), are confirmed by examination of type material of these species.

Fullaway (1917) described and illustrated both sexes of *Spalangia philippinensis* (Hymenoptera: Pteromalidae) from a culture that had been established in 1914 from house fly, *Musca domestica* L. (Diptera: Muscidae), puparia and other muscid puparia collected in the Philippines. The parasitoids were propagated and released in Hawaii as part of a control program for the horn fly, *Haematobia irritans* (L.) (Diptera: Muscidae). Fullaway briefly compared his new species to *S. cameroni* Perkins, 1910, but did not state the number of females and males he had before him, nor select a holotype or state where type material was deposited.

Bouček (1963) revised the world species of *Spalangia* Latreille. In this work he synonymized *S. philippinensis* under *S. endius* Walker, 1839, based on two females that Fullaway had sent him "of his species", and newly described *S. gemina* based on females and males from Mauritius, India, Thailand, Malaysia, Fiji, and Venezuela. The name *S. philippinensis* has not been used in any scientific publication since Bouček (1963) except as a synonym of *S. endius* or in simple lists of taxa. In contrast, extensive information has been published under the name *S. gemina*, including research on its life history (Morgan et al. 1989, 1991), biological attributes (Costa 1995; Geden 1999, 2002) and host-parasitoid modelling (Geden 1996, 1997). Several publications also compare it to other *Spalangia* species or list new distribution and host records (see Noyes 2003 for summary), and three partial sequences of the 12S and 28S ribosomal RNA genes have been deposited in GenBank under the name *S. gemina* (accession numbers AF289673, AY855200 and AY8500201).

As part of research investigating the identity and diversity of chalcid parasitoids of filth-breeding flies in North America, I borrowed type material of three species of *Spalangia* housed at the Bernice P. Bishop Museum, Honolulu, Hawaii (BPBM). The material included a single female syntype of *S. cameroni* (labelled as holotype no. 1578), a male and female syntype of *S. simplex* Perkins, 1910

(mounted together on one card and labelled as holotype no. 1579), and a female labelled "type" and a male labelled "type ♂" of *S. philippinensis*. The latter two specimens were mounted separately on square cards[1] and additionally bore three identical printed labels with "Honolulu H.T.", "D.T. Fullaway collector" and "Insectary".

Bouček examined the male type of *S. endius* in The Natural History Museum, London (BMNH), but he did not have the opportunity to examine type material of *S. cameroni*, *S. philippinensis* or *S. simplex*. My study of the type specimens of *S. cameroni* and *S. simplex* confirmed Bouček's (1963) interpretation of these two names. However, examination of the BPBM specimens labelled as type and male type of *S. philippinensis* revealed that the female is conspecific with *S. gemina* and the male is conspecific with *S. cameroni*. Following this discovery, I investigated whether collections of the Department of Entomology, University of Hawaii, Manoa (UHM) and the Hawaii Department of Agriculture, Division of Plant Industry, Honolulu (HDOA) possessed any other potential syntypes of *S. philippinensis*. The UHM collection contains no specimens identified as *S. philippinensis*, but I received three females labelled as *S. philippinensis* from HDOA. One of the HDOA females bears three labels with "Honolulu Oahu", "original cotype" and "Type material *Spalangia philippinensis*". The latter label is of the same red paper and *Spalangia philippinensis* is in the same handwriting as the type labels of the two BPBM specimens. The female is mounted upside down on a plastic point so that its propodeum is concealed, and it lacks its head and antennae, but sculpture of the pronotum indicates it is a *S. endius* female. The other two HDOA females are also *S. endius*. One is point-mounted and bears three printed labels with almost the same data as the BPBM specimens, "Honolulu Oahu", "D.T. Fullaway collector", and "Insectary". The other female bears a single handwritten label with "Honolulu Oahu"; it is also point-mounted but has a minuten pin through the point that is pinned into a circular piece of paper pierced by a second, larger pin. Consequently, three specimens are labelled variously as "types" of *S. philippinensis* and these comprise three different species—*S. endius* Walker, *S. cameroni* Perkins, and *S. gemina* Bouček. I therefore studied the original description and illustrations in Fullaway (1917) (dorsal habitus of female *S. philippinensis* and female and male antenna of *S. philippinensis* and *S. cameroni*) in an attempt to determine which species, under current concepts, was described as *S. philippinensis*. The purpose of this paper is to select a lectotype for *S. philippinensis* that least affects stability of existing nomenclature while still being compatible with the original concept and description of Fullaway (1917).

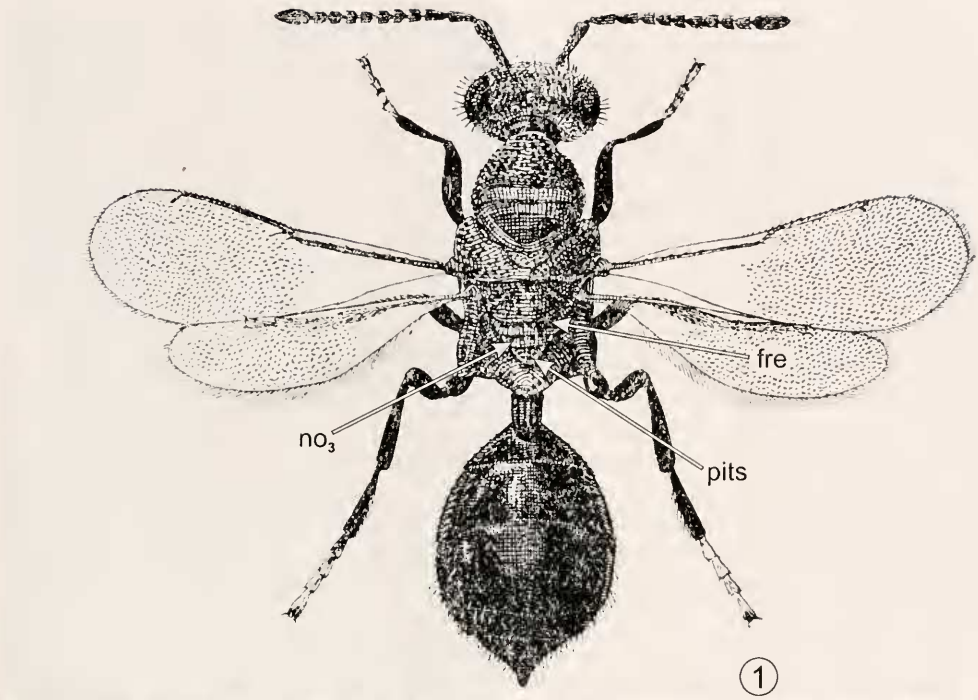
MATERIALS AND METHODS

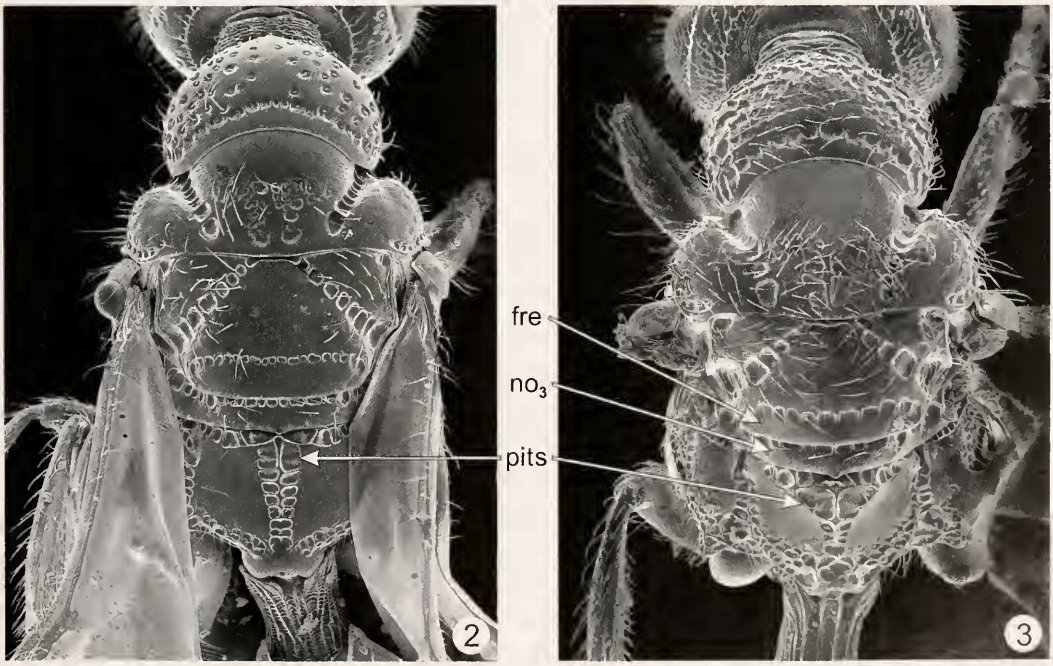
My concepts of *S. gemina* and *S. endius* are based on Bouček (1963). Terms for structure follow Gibson (1997). Relative measurements were taken with a Nikon SMZ-1500 microscope fitted with a 10 mm ocular grid having 100 divisions. Scanning electron photomicrographs of type-series specimens of *S. philippinensis* were taken using an environmental SEM and digitally retouched using Adobe Photoshop™ in order to enhance clarity.

RESULTS

Gibson (2000) provided an illustrated key that differentiates *S. cameroni*, *S. gemina* and *S. endius* from other introduced and native species of *Spalangia* that are parasitoids of filth flies (Diptera: Muscidae) in North America. Features used to differen-

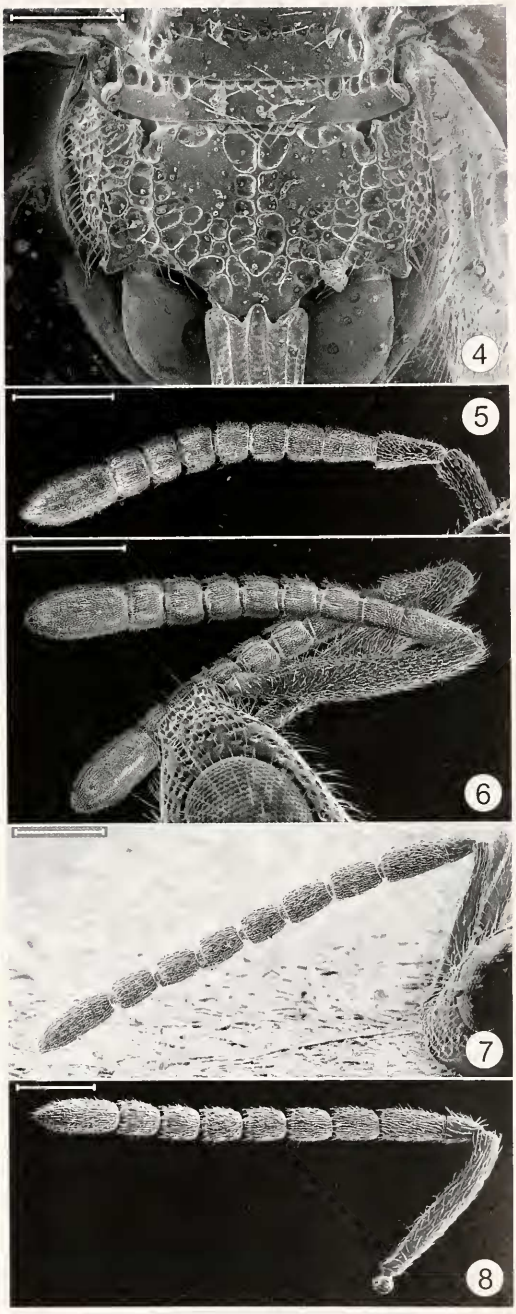
[1]The female was partly broken and detached from the card except by the apex of one fore wing when it arrived; I therefore point-mounted it and pinned below it the original card with pieces of the specimen still attached.



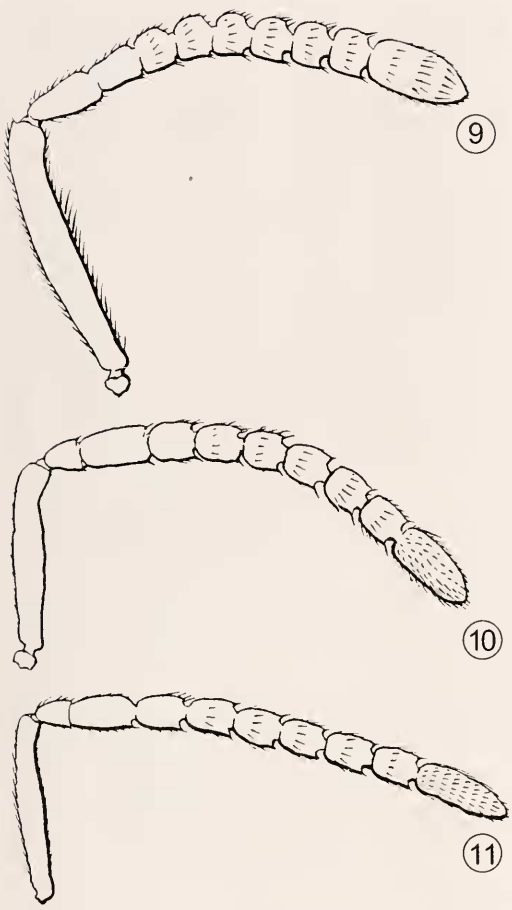


Figs 1–3. 1, *Spalangia philippinensis*, original habitus drawing adapted from Fullaway (1917). 2, *S. cudius*, dorsal mesosoma. 3, *S. philippinensis*, BPBM female paralectotype, dorsal mesosoma. (Abbreviations: fre = frenum, no_3 = metanotum, pits = anterior cells of paramedian crenulate furrows.) Scale bar = 200 μ.

tiate *S. endius* from *S. cameroni* and *S. gemina* include differences in sculpture of the pronotum and propodeum, and a difference in the setal pattern of the fore wing of males. *Spalangia endius* has the pronotum comparatively sparsely punctate with circular depressions separated by flat, shiny interspaces (Fig. 2), whereas *S. cameroni* and *S. gemina* belong to a group of species that share a rugulose-reticulate pronotum, the depressions being so crowded as to be irregular (Fig. 3). There is also a conspicuous difference in propodeal sculpture between *S. endius* and the other two species. Although all three species have a transverse row of crenulae along the anterior margin of the propodeum (Figs 2, 3), in *S. endius* the paramedian crenulate furrows posterior to the transverse row of crenulations are parallel or only slightly and evenly widened anteriorly so as to form a narrowly V-shaped sculptural complex. Furthermore, the anterior most cells of the paramedian crenulate furrows are similar in size to the other cells of the furrows (Fig. 2). In contrast, both *S. cameroni* and *S. gemina* have the paramedian crenulate furrows obviously widened anteriorly so as to form more of a Y-like sculptural complex, with the anterior most cell or cells on either side of the median carina being conspicuously larger than the more posterior cells and usually also tapered posteriorly (Figs 3, 4). Based on these two features, both the original description and the female habitus illustration of *S. philippinensis* given by Fullaway (1917) (reproduced here as Fig. 1) demonstrate that the species could be *S. gemina* and/or *S. cameroni*, but not *S. endius*. Although the original female habitus illustration is not detailed, the pronotum is obviously coarsely sculptured (Fig. 1). Furthermore, the description of the female states "pronotum rugose and hairy", which accurately describes the pronotum of the BPBM female (Fig. 3) and male, but does not correctly describe the pronotum of any of the three HDOA females (Fig. 2).



Figs 4–8. 4, *Spalangia philippinensis*, male lectotype propodeum. 5–8 antenna. 5, *S. philippinensis*, BPBM female paralectotype (= *S. gemina*). 6, *S. philippinensis*, HDOA female paralectotype (= *S. endius*). 7, *S. philippinensis*, male lectotype (= *S. cameroni*). 8, *S. gemina*, male. Scale bar = 200 μ.



Figs 9–11. Line drawings of antennae reproduced from Fullaway (1917). 9, *Spalangia philippinensis* female. 10, *S. philippinensis* male. 11, *S. cameroni* male.

The female description also states "a longitudinal carina divides it [propodeum], in front passing between two rather large shallow pits and behind flanked on either side by a punctate line or furrow". The female habitus clearly illustrates the described pits as a triangular region (Fig. 1, pits) posterior to the scutellar frenum and metanotum (Fig. 1, fre, no_3), similar to that of the BPBM female (Fig. 3) and male (Fig. 4) but not to the propodeal sculpture of the HDOA females (Fig. 2). Finally, although the fore wing is entirely bare within the basal one-third of both sexes of *S. gemina* and *S. cameroni*, males of *S. endius* have conspicuous setae within and defining the basal cell (see figures in Gibson 2000). For *S. philippinensis* the female fore wing was described as "ciliate outwardly from the juncture of submarginal with marginal but basally bare" (Fig. 1). The male of *S. philippinensis* was described only relative to how it differed from the female and the description does not mention any difference in fore wing setation between the sexes; therefore, a basally bare fore wing must also be assumed for the male. This represents a third feature that indicates Fullaway was describing either *S. cameroni* or *S. gemina* but not *S. endius* as *S. philippinensis*.

In his key to species, Bouček (1963) differentiated *S. gemina* from *S. cameroni* based on slight differences in head shape and antennal structure. Females of *S. cameroni* were stated to have the second funicular segment oblong and the distal segments quadrate, whereas females of *S. gemina* were stated to have the second funicular segment subquadrate and the following segments transverse. The female description of *S. philippinensis* states "1st funicular joint about equal to pedicel, the next two joints about as broad as long, the four following ones a trifle wider than long". This accurately describes the antenna of the BPBM female labelled as type (Fig. 5) and the female antenna Fullaway illustrated as *S. philippinensis* (reproduced here as Fig. 9), but conflicts with the antennal structure of female *S. endius*. Females of *S. endius* have the first funicular segment obviously shorter than the pedicel (Fig. 6), a fourth feature that suggests Fullaway's concept of *S. philippinensis* was not in the sense of *S. endius*. Bouček (1963) further stated that males of *S. cameroni* have the distal funicular segments clearly oblong compared to hardly longer than broad for males of *S. gemina*. The male description of *S. philippinensis* states "the first funicle joint long ...and the other funicular segments all longer than wide". The BPBM male syntype has all the funicular segments obviously oblong

(Fig. 7), which is more similar to the male antenna that Fullaway illustrated as *S. cameroni* (reproduced here as Fig. 11) than to the original illustration provided for the male of *S. philippinensis* (reproduced here as Fig. 10) or to the antenna characteristic of males of *S. gemina* (Fig. 8). Bouček (1963) also described a difference in genal length between females of *S. cameroni* and *S. gemina*. In *S. cameroni* females the gena was described as being slightly longer than the relatively small eyes, whereas in *S. gemina* it was said to be shorter than the width of the eye. This difference was restated by Gibson (2000), who also described males of *S. cameroni* as having the gena only slightly less than the width and at least two-thirds the length of an eye, in contrast to males of *S. gemina*, which have the gena distinctly less than the width and less than half the length of an eye. The original description of the male of *S. philippinensis* states that the head is shorter than for the female, but no mention is made of the length of the gena, which for the female is described as "cheeks flat and as long as the eyes". This latter statement suggests that a female of *S. cameroni* rather than *S. gemina* was being described as *S. philippinensis*, but it conflicts with the description and illustration of the female antenna and is the only statement in the female description that does not accurately reflect the BPBM female labelled as type. In this female, relative measurements of eye width: eye length: maximum genal length = 47 : 62 : 50. The same relative measurements for the BPBM male are 39 : 51 : 40.

DISCUSSION

Multiple species of *Spalangia* are commonly reared as part of surveys of pupal parasitoids of filth-breeding flies. Sulaiman et al. (1990) reared *S. cameroni*, *S. endius* and *S. gemina* along with another species, *S. nigroaenea* Curtis, 1839, in a survey in peninsular Malaysia. Fullaway established his colony from the puparia of *Musca domestica* as well as other muscid puparia collected in the Philippines. It is therefore quite likely that his colony, and the type series of *S. philippinensis* taken from it, was composed of more than one species. The BPBM female labelled as "type" and the male labelled as "type ♂" of *S. philippinensis*, which are also labelled "Insectary", show that the colony consisted of at least two species, *S. gemina* and *S. cameroni*, respectively. Under material examined for *S. endius*, Bouček (1963) listed the data "Hawaii: Philippine *Spalangia*" for the two females that Fullaway sent to him as his species. Consequently, the specimens may have been adults collected in the Philippines rather than cultured specimens and if so are not part of the original type series and therefore ineligible for lectotype designation. However, the HDOA female labelled as "original cotype" and with a red type label similar to the BPBM specimens is *S. endius*, and because of its labels I accept it as a third syntype of *S. philippinensis*. I also interpret as a syntype the HDOA female with almost the same labels and data as the BPBM specimens. I exclude from the type series the HDOA female that has only a single handwritten label because there is no indication that it was a Fullaway specimen or that it originated from the insectary. Regardless, the four remaining specimens I interpret as syntypes indicate that the colony from which *S. philippinensis* was described consisted of at least *S. cameroni*, *S. gemina* and *S. endius*. Therefore, designation of a lectotype is necessary to fix the meaning of *S. philippinensis*.

The current International Code of Zoological Nomenclature (ICZN 1999) recommends that to preserve stability of nomenclature an author should act consistently with or at least give great weight to previously accepted taxonomic restrictions of the application of the name when designating a lectotype (recommendation 74A). For *S. philippinensis*, such stability could be achieved by designating one of the two HDOA syntype females as lecto-

type, which would retain Bouček's (1963) synonymy of *S. philippinensis* under *S. endius*. However, fixation of the name in the sense of *S. endius* would be demonstrably incorrect based on the original description and illustrations of *S. philippinensis* provided by Fullaway (1917). I consider such an obviously incorrect nomenclatural action as inappropriate, even though Fullaway also misinterpreted his species many years after the original description when he sent specimens to Bouček. The original description and illustrations clearly demonstrate that one or both of *S. cameroni* and *S. gemina* were described as *S. philippinensis*. Fullaway's brief comparison of his new species with *S. cameroni* demonstrates that he was aware of the latter species and considered that it was distinct, but it is unclear whether the differential features he gave (stouter antenna with first funicle joint more or less obconic, and shorter club) referred to the female of *S. philippinensis* only. There are also discrepancies in the descriptions and illustrations that suggest these might have been from a mixed series of *S. cameroni* and *S. gemina*. The description of the female antenna matches that of *S. gemina* and the BPBM female labelled as type, whereas the description of the cheeks suggests a female of *S. cameroni* was being described. The illustration of the male antenna of *S. philippinensis* (Fig. 10) is certainly more characteristic of *S. gemina* (Fig. 8) than *S. cameroni* (Fig. 7), but the corresponding description states that the funicular segments beyond the first segment are all "longer than wide", which is characteristic of *S. cameroni* and certainly descriptive of the antenna of the BPBM specimen labelled as male type of the species (Fig. 7). There is no information in the original publication concerning whether the illustrations were prepared from the actual specimens used by Fullaway to prepare the descriptions, or from other colony specimens, and it is certain that the colony consisted of a mixed culture. The original description and illustrations clearly demonstrate that *S. philippinensis* was established in the sense of *S. gemina* or *S. cameroni*, but it can not be stated unequivocally that it was in the current sense of only one of these two names. Although the description of the female is the primary description for the species and the BPBM female is labelled as "type", no holotype was selected in the original description. I therefore designate the BPBM male, labelled as "type ♂, *Spalangia philippinensis*", as lectotype of *S. philippinensis*. I designate the corresponding BPBM female and the two HDOA females discussed above as paralectotypes and have added my lectotype and paralectotype labels to the respective specimens. The selection of the BPBM male as lectotype is at least compatible with the original description of *S. philippinensis*. It also minimizes disruption of current nomenclature because it retains the name as a junior synonym and avoids the synonymy of *S. gemina* Bouček, a name with an extensive modern literature, which would result if the BPBM female was selected as lectotype of the species. I therefore remove *S. philippinensis* Fullaway, 1917, from synonymy with *S. endius* Walker, 1839, and newly synonymize the name with *S. cameroni* Perkins, 1910, **syn. nov**.

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